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THE EFFECT OF THE ATTITUDE OF THE SUBJECT UPON THE MEASURE OF SENSITIVITY

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Some time ago, in an experimental study in lifted weights, the results of one subject showed that in a series of 1,200 judgments he had not judged a single pair as equal.¹ In such a series of results the thresholds in the directions of increase and decrease coincide; and hence the interval of uncertainty and the measure of sensitivity are zero. Woodworth² in a recent study remarks that theoretically this could happen and hence concludes that the interval of uncertainty is a poor measure of individual differences. As regards the first part of this statement, we agree. The interval of uncertainty should theoretically and does empirically reduce to zero. This is obvious inasmuch as the size of the interval of uncertainty is directly dependent upon the relative number of equality judgments which the subject may report in any given series. But the fact that this measure may reduce to zero is not a valid reason for believing that it is not a good test for individual differences. The thresholds that determine the interval of uncertainty are defined in terms of probabilities; and as such they are open to variation from a number of influences. Many of the objective factors that may cause such variation have been analysed from the total complex. For instance, we have standardized the psychophysical procedure so that the time and space errors may be eliminated. Woodworth believes that this reduction of the interval of uncertainty to zero, in an apparently normal series from the objective side, is due to a subjective factor. In our paper, mentioned above, we drew the same conclusion and stated that we believed that this was due to the subjective attitude of the subject inasmuch as he set for himself the *Aufgabe* of look-

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¹ S. W. Fernberger, On the elimination of the two extreme intensities of the comparison stimuli in the method of constant stimuli. *Psychol. Rev.*, XXI, 1914, pp. 335-355.

² R. S. Woodworth, Professor Cattell's Psychophysical Contributions. *Arch. of Psychol.*, No. 30, 1914. 66f.

ing for a difference. But this introduction of a subjective factor does not invalidate the interval of uncertainty as a measure of individual differences. We must only note one other factor that must so far as possible be controlled in our experimental arrangement. It is of course true that since this is a subjective factor, it will be much more difficult to control than objective factors; but with trained subjects at least, introspections should reveal how nearly they have accepted the instructions of the experimenter. A measure of individual differences such as Woodworth apparently has in mind, would measure mere sensitiveness of the peripheral end-organ and not the sensitivity of the psychophysical organism with regard to our stimuli and our objective conditions.

Brown³ has unwittingly shown most clearly the effect of the instructions upon the relative number of equality judgments. He strongly impressed upon his subject that she should be able to find a difference between each of his pairs of stimuli provided that she concentrated enough upon the judgment. Thus, by his instructions, he emphasised the attitude of looking for a difference; and the subject gave practically no equality judgments in a long series of liftings.

In order to test further our hypothesis that these variations were due to the attitude or *Einstellung* set up in subject by the *Aufgabe* or the acceptance of the instructions, we devised the following experiment in lifted weights. The usual series of seven pairs of weights were prepared, the standard weight of each pair being 100 grams, and the comparison weights 84, 88, 92, 96, 100, 104 and 108 grams. By means of a table provided with a revolving top we eliminated the space errors. The time errors were present in the first order but were kept constant by having the lifting controlled by the beats of a metronome.⁴ The results were treated by the method of constant stimuli as developed by Urban. Fifty judgments upon each of our seven pairs of stimuli were recorded for each subject after he had been given a sufficiently long period of preliminary practice to mechanize the hand movements.

Fourteen subjects were employed, all of them graduate students in psychology at Clark University. None of these students knew this particular technique of lifting, before the

³ Warner Brown, The judgment of difference, *Univ. of California Pub. in Psychol.*, I, No. 1, 1910, 1-71.

⁴ For a detailed description of the type of stimuli employed, their arrangement upon the table, and the manner of lifting cf. S. W. Fernberger, On the relation of the methods of just perceptible differences and constant stimuli. *Psychol. Rev. Monographs*, XIV, No. 4 (Whole No. 61), 1913, 7-18.

experiment; and none of them was sufficiently well acquainted with the previous studies in psychophysics to be biased in the judgments. Furthermore, none of the subjects was informed of the problem which we were attacking. These subjects were divided into two groups of seven each. The stimuli were presented in a similar manner to the different subjects of these two groups and the conditions of the experiment remained as rigidly constant as possible, except for the instructions given the subjects at the beginning of the experiment.

The instructions for the technique of lifting and the like were similar for both groups. When we came in our discussion to describe the different categories of judgment to be employed, we here varied our instructions for the two groups. To Group I, we gave the normal instructions usually given to subjects for the method of constant stimuli: "You are to judge whether the second weight is heavier, equal or lighter than the first weight in each pair. There may be times when a doubtful judgment may occur, that is, when you are unable to decide whether the second weight in a given pair is lighter, equal or heavier than the first weight. In such a case announce your judgment as equal." Exactly similar instructions were given to Group II, except that we then added: "There has been more or less discussion in the literature of psychophysics as to the admission of the equality judgment. Some writers believe that it should be excluded. In my own experience, I find that the equality judgment does occur, both as actual subjective equality between the two stimuli of a pair, and also as doubtful judgments. I believe that you will find also that the equality judgment does occur in this series. Let me caution you, however, not to force any equality judgments; but do not hesitate to give such judgments if they do occur. Judge these stimuli honestly and to the best of your ability, but do not allow yourself to be prejudiced against giving them by any studies which you may have seen, which recommend that the equality judgment should be eliminated." We were exceedingly careful that the instructions should be given accurately to the different subjects in the two groups; and the subjects were requested not to discuss the experiment with any other students.

We believe that by means of these instructions we succeeded in giving different *Aufgaben* to our two groups of subjects, and as a result, different *Einstellungen* toward the problem. The usual instructions, such as we employed in the case of Group I, seem to give the subject the attitude of looking for a difference rather than of using equally his three categories

of judgment. This attitude may have given rise to the entire question in the literature of eliminating the equality judgment, because the subject uses the three categories differently. Working under the influence of his *Aufgabe*, he first searches for a difference; and when he fails in this, he then turns toward the equality judgment. On the other hand, by emphasising the equality judgment, as we did in our instructions to Group II, we believe that we made the three categories of more nearly equal value.

The effect of these different *Aufgaben* and the resultant attitudes toward the experiment, become evident when we examine the size of the intervals of uncertainty obtained for the two groups. These values for Groups I and II appear in Tables I and II respectively. The tables are similarly constructed. The subjects are indicated in the first columns; in the second columns are given the values of the interval of uncertainty ($S_2 - S_1$) for each of the subjects. In the third columns are recorded the value of the measure of sensitivity $\left[\frac{S_2 - S_1}{2} \right]$. Finally in the last columns are to be found the values assumed by the point of subjective equality $\left(\frac{c_1 + c_2}{h_1 + h_2} \right)$ for the different subjects. In the bottom rows of the tables will be found the averages of the values in each of the columns.

When we compare the values of the interval of uncertainty for the different subjects, we find that those obtained from Group II,—with whom the equality category was emphasised in the instructions,—are very much larger than those from Group I,—who worked under normal instructions. Indeed, the largest individual value for this interval for Group I is smaller than the smallest value for Group II. On the other hand, the values obtained for Group I,—who worked under the normal instructions,—are quite similar to those obtained from other studies where a similar technique was employed.⁵ Thus the intervals for Group II are considerably above the normal. The difference between the averages for the two groups is exceedingly large, being 3.504 grams. This is nearly 63 per cent. of the average value for Group I. Hence the interval of uncertainty for Group II is considerably more than half as large again as that for the first group. Obviously

⁵ cf. F. M. Urban, *The Application of Statistical Methods to the Problems of Psychophysics*, Phila., 1908.
S. W. Fernberger, *ibid.*

the same relations hold for the measure of sensitivity since it is merely one-half of the interval of uncertainty. On the other hand, the averages of the points of subjective equality for the two groups are exceedingly similar, being 95.77 grams for Group I and 96.22 grams for Group II, a difference of only 0.45 grams. Such a variation is well within the limits of what one might expect in such an investigation. This means that although the relative number of equality judgments for the two groups varied considerably, still the relative number of heavier and lighter judgments showed little variation one with the other. Or in other words, in Group I the judgments which were not given as equal were divided between the heavier and lighter categories with approximately the same relative frequency as these two categories occurred for Group II.

It would seem that the exceedingly large variations in the size of the interval of uncertainty indicate that Group I had a higher sensitivity than Group II. But we do not believe that this is the case. One can not measure sensitivity in absolute terms; one can only say that a given sensitivity has been found to exist *under certain given experimental conditions*. Inasmuch as we are dealing with a total psychophysical organism and not merely with a sense-organ, it is, after all, not surprising that the attitude of the subject should have a profound effect upon this sensitivity. The above results indicate that this is true empirically. The investigation of such subjective factors is one of the main problems of the psychophysical methods. The similarity of the results in former studies indicates that for most subjects, similar instructions will arouse similar attitudes toward the experiment. Now and then a subject will set for himself a different *Aufgabe* than the one which the experimenter tries to have him accept. Usually this is because the subject desires to 'do well' and believes that the giving of equality judgments is an indication that he can not discriminate so accurately. Such a reaction is to be found in the subject described in our former study. But in such a case, the experimenter is able, quite readily, to ascertain this fact from the exceedingly small size of the interval of uncertainty itself. The experimenter should be able to ascertain the attitude and *Aufgabe* of the trained subject from the introspective reports. But for the untrained subject—that is, if the methods be applied for diagnostic or anthropometric purposes—the methods must be used with greater caution and with a realization of the fact that here is

a subjective factor which may cause exceedingly large variations in the measure of the sensitivity of the subjects.

TABLE I

Subjects	Interval of Uncertainty	Measure of Sensitivity	Point of Subjective Equality
I	6.28	3.14	94.72
II	5.80	2.90	95.22
III	6.74	3.37	98.23
IV	4.91	2.45	92.98
V	7.08	3.54	96.96
VI	3.64	1.82	95.54
VII	4.50	2.25	96.75
Average.....	5.56	2.78	95.77

TABLE II

Subjects	Interval of Uncertainty	Measure of Sensitivity	Point of Subjective Equality
I	7.32	3.66	97.86
II	7.72	3.86	97.02
III	10.70	5.35	95.00
IV	8.79	4.40	95.87
V	9.22	4.61	96.42
VI	9.36	4.68	94.38
VII	10.37	5.18	96.96
Average.....	9.07	4.53	96.22